

REMARKS

Applicant would like to thank the Examiner for the careful consideration given the present application. The application has been carefully reviewed in light of the Office action, and amended as necessary to more clearly and particularly describe the subject matter which applicant regards as the invention.

Initially, it is noted that claim 1 has been amended to clarify the operation of the fourth step of the method of estimating the joint moment. It is submitted that this amendment is of a clarifying nature, and does not significantly change the scope of the claim. Therefore, it does not raise a new issue requiring further search or consideration by the Examiner. Thus, entry of the amendment to claim 1 is considered to be proper and, accordingly, reconsideration of the application in its current form is requested.

The Examiner has rejected claim 1 under 35 U.S.C. 102(b) as being anticipated by "The Concept of a Walking Assistance Suit" to Kato. The Examiner's rejection is traversed for the following reasons.

The present invention relates to a method of estimating a joint moment of a bipedal walking body. The method includes a first step for sequentially grasping the displacement amounts of a plurality of joints, including at least an ankle joint, a hip joint and a knee joint of each leg of a bipedal walking body, and a second step for sequentially grasping the positions and/or postures of corresponding rigid bodies of the bipedal walking body that are associated with rigid elements of a rigid link model using at least the rigid link model. The rigid link model is established beforehand to express the bipedal walking body in the form of a link assembly composed of a

plurality of the rigid elements and a plurality of joint elements and the grasped displacement amounts of the joints. The method further includes a third step for grasping the acceleration of a preset reference point of the bipedal walking body by using at least an output of an acceleration sensor attached to a predetermined region of the bipedal walking body, and a fourth step for sequentially grasping a floor reaction force acting on each leg and the position of an acting point of the floor reaction force. The grasped positions and/or the postures of the corresponding rigid bodies of the bipedal walking body, the floor reaction force and the position of the acting point of the floor reaction force being changeable every moment, the acceleration of the reference point, the floor reaction force, and the position of the acting point of the floor reaction force are used to estimate a joint moment acting on at least one joint of each leg. At least the displacement amounts of the hip joint, the knee joint, and the ankle joint of each leg that are grasped in the first step include the amount of rotation about an axis substantially perpendicular to a leg plane as a plane passing through these three joints. The displacement amount of the hip joint is a three-dimensional amount, and the positions and/or postures of the corresponding rigid bodies grasped in the second step include at least the positions and/or the postures of the corresponding rigid bodies of the leg on the leg plane, the acceleration of the reference point grasped in the third step and the floor reaction force and the position of the acting point of the floor reaction force grasped in the fourth step are three-dimensional amounts. A component of a joint moment acting on at least one joint of the leg about the axis that is substantially perpendicular to the leg plane is estimated on the basis of an inverse dynamic model representing the relationship between the motions of the corresponding rigid bodies of the leg and the

translational forces and the moments acting on the corresponding rigid bodies on the leg plane by using the two-dimensional amounts obtained by projecting at least the acceleration of the reference point, the floor reaction force, and the position of the acting point of the floor reaction force onto a leg plane related to the leg on the basis of a displacement amount of the hip joint of the leg, and the positions and/or the postures of the corresponding rigid bodies of the leg on the leg plane.

Kato involves the research of walking assistance suits. In particular, Kato concludes that to prevent muscle decay, humans must use about 30% or more of their maximum muscle strength. Additionally, the floor reaction force can approximately be estimated from each joint angle measurement value and the displacement estimation value of the center of gravity without using any large-scale measuring equipment.

Claim 1 of the present application recites "a first step for sequentially grasping the displacement amounts of a plurality of joints, including at least an ankle joint, a hip joint and a knee joint of each leg of a bipedal walking body." Review of Kato does not reveal this step. In support of this rejection, the Examiner indicates that "Kato discloses a three-dimensional motion analyzer (lines 15-16) for each leg joint (pg 11) and finding moments, or rotation about an axis perpendicular to the leg of the ankle, knee, and hip joints (pg 11, line 20-pg 12)" (Final OA; Pg. 6, Sect. 5). However, review of the cited section of Kato fails to disclose that the displacement amounts are determined in any specific order as required by claim 1 of the present application. Therefore, Kato cannot be cited for disclosing "a first step for **sequentially** grasping the displacement amounts of a plurality of joints, including at least an ankle joint, a hip joint and a knee joint of each leg of a bipedal walking

body." Accordingly, removal of the rejection of claim 1 is hereby requested.

Claim 1 also recites that "at least the displacement amounts of the hip joint, the knee joint, and the ankle joint of each leg that are grasped in the first step include the amount of rotation about an axis substantially perpendicular to a leg plane as ***a plane passing through these three joints.***" In support of this rejection, the Examiner points to Pgs. 10-12 of Kato and also indicates that "Kato discloses a three-dimensional motion analyzer (lines 15-16) for each leg joint (pg 11) and finding moments, or rotation about an axis perpendicular to the leg of the ankle, knee, and hip joints (pg 11, line 20-pg 12)" (Final OA; Pg. 6, Sect. 5). However, review of the cited sections fails to reveal any discussion whatsoever of the displacement amounts of the hip joint, the knee joint, and the ankle joint being measured about an axis that is substantially perpendicular to a leg plane as a plane passing through these three joints as required by claim 1. In fact, Kato provides no guidance about from which plane the joints are measured. Therefore, removal of the rejection of claim 1 is requested.

The Examiner has rejected claims 2-7 under 35 U.S.C. 103(a) as being unpatentable over Kato in view of U.S. Pat. No. 6,289,265 to Takenaka et al. The Examiner's rejection is traversed for the following reason.

Takenaka involves a controller for a legged mobile robot. In particular, Takenaka relates "to a posture control system of a legged mobile robot, and more specifically a system for conducting a compliance control on the motion of the legs of a legged mobile robot, in particular a biped robot, and controls the floor reaction force acting on the robot appropriately" (Col. 1, lines 7-12).

Takenaka does not correct the deficiencies of Kato. More specifically,

Takenaka concerns an entirely different concept and does not conduct any estimation as recited in claim 1 of the present application. Therefore, even if the references were combined, they would still be deficient. Thus, the Examiner has failed to provide a *prima facie* case of obviousness of claim 1, from which claims 2-7 depend. Therefore, the rejection of claims 2-7 must be withdrawn.

In light of the foregoing, it is respectfully submitted that the present application is in a condition for allowance and notice to that effect is hereby requested. If it is determined that the application is not in a condition for allowance, the Examiner is invited to initiate a telephone interview with the undersigned attorney to expedite prosecution of the present application.

If there are any additional fees resulting from this communication, please charge same to our Deposit Account No. 18-0160, our Order No. SAT-16451.

Respectfully submitted,

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